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Programme management of world bank financed small hydropower development in Zhejiang Province in China

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ABSTRACT

The Government of China (GOC), in conjunction with the World Bank (WB) and the Global Environment Facility (GEF), has recently developed the China Renewable Energy Scale-up Programme (CRESP). The latter involves an analysis of the current state of renewable energy resources in China as well as the implementation of a renewable energy scale-up development based on pilot work. Using the Zhejiang Small Hydropower Programme financed by the WB as a real-world application case study, a comparison is made between the project management policies espoused in China and those of the WB, with management constraints being examined in detail. Owing to the need for certain modifications to current management techniques, a framework model of programme management is put forward, with the project management office (PMO) at its core, and staged implementation and multi-level management constituting its principal methods. In addition, this model of programme management meets the requirements concerning the policies and procedures stipulated by the WB, with other benefits including a reduction in terms of cost as well as in the duration of the construction of related subprojects. This is especially relevant if we take into consideration the sheer number of small hydropower plants and the diversity of their locations throughout China. This model should therefore be considered for promoting the scale-up development of small hydropower and other renewable energies in China, and its application may have a wider significance.

Contents

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1. Introduction

Since its first loan, which was granted in 1981 to support the development of Chinese universities [1], by June 30, 2011, the World Bank's cumulative lending to China had reached approximately US $49.15 billion, covering a total of 337 development projects [2], and making China's portfolio one of the largest in the Bank. Indeed, the Bank's loans to China have played a significant role both in the relief of poverty and in the promotion of sustainable development. As environmental policy now plays an important role in the agenda of China's new government, World Bank (WB) funds and international cooperation are of equal importance for reforming energy policies and enforcing environmental protection, which are in fact two areas of particular global concern [3–7]. In order to alleviate energy shortages while decreasing greenhouse gas emissions, China has recently initiated energy policy reforms to improve energy efficiency, decrease energy consumption, and to promote renewable energy generation [8–13].

Hydropower is an important source of renewable energy towards which the most recent technological developments have been directed, thus creating great potential for large-scale commercial exploitation. By 2010, the gross installed hydropower capacity of China had reached 200 GW, ranking first in the world and consuming 24% of the country's total power-generating capacity [14]. Over a century of hydropower generation, the cumulative energy produced has amounted to 7.299 trillion kWh, which is equivalent to an energy output of 2.7 billion tons of standard coal, resulting in a reduction in carbon dioxide emissions by 7 billion tons [14]. There are more than 45,000 small hydropower plants with a total installed capacity of over 59 GW, and the annual energy produced amounting to 200 billion kWh [15]. Small hydropower is the major power source for a quarter of the total population in one-third of all counties, covering almost half of the land in the country [16]. After decades of development, small hydropower has not only increased power reserves, responding to power emergencies and improving energy infrastructure, but it also plays a significant role in environmental protection [13].

Scale-up development is the best method for small hydropower to achieve social and economic recognition while keeping development and operation costs low. The important issue the Chinese government is facing is how to set up an optimal development and incentive policy. To date, 34 technological standards concerning small hydropower development have been issued to improve their technical level, regulate developmental procedures and mitigate negative impact on environment and resettlement. During the implementation process of hydropower electricity generating projects in rural areas and the modernisation of traditional power trees and straw fuel by small hydropower, the government has provided financial subsidies to the industry in the form of favourable tax policies and price fixation. In addition, the Renewable Energy Law of the People's Republic of China promulgated in 2006 provides legal support for the implementation and reform of the renewable energy policy. Currently, the small hydropower resources utilised only account for 34% of the total potential. In 2010, China embarked on a plan to ensure even greater potential for energy generation involving the refurbishment of 9612 small hydropower plants in rural areas, with a total capacity of 9,834.9 MW. On the other hand, the rapid increase of development costs, financial shortages, and inadequate efforts to protect the environment and manage resettlement have also been exposed during the development process of small hydropower plants. These particular challenges should act as an incentive for China to strengthen international cooperation, reform management methods, and open new financing channels.

In view of the above, while the Government of China (GOC) was developing the Renewable Energy Scale-up Programme (CRESP) in cooperation with the WB and the Global Environment Facility (GEF), the small hydropower development project in Zhejiang was included in Phase I, aiming for the gradual implementation of a renewable energy scale-up development as well as the provision of cost-effective and commercial renewable energy electricity to the electric power market [7]. CRESP is a 10–12 year endeavour to be implemented in three phases. In Phase I, a WB loan of US $173.33 million was sought for pilot scale-up renewable energy investments, and a GEF grant of US$40.22 million was approved by the GEF Council in order to finance CRESP institutional development and capacity building.

The successful implementation of WB-supported projects depends on a number of factors [17]. Although there is considerable social demand and sound policy support for the scale-up development of small hydropower in China, there are many problems inherent in the efficient use of WB loans for its development. These problems include the following: (i) due to variable plant conditions and locations, both fixed and simple models of development are scarcely applicable to small hydropower projects; (ii) most small hydropower resources are in the mountains in economically underdeveloped areas where there is an obvious lack of start-up capital; (iii) a deficit of qualified technicians in these rural areas leads to poor management and poor capacity for identifying and controlling risks during project implementation; and (iv) previous WB-financed projects in China have mostly been single large-scale projects and the experience acquired from them is not necessarily applicable to managing a group of disparate small hydropower projects, each with its unique set of characteristics. Furthermore, significant differences between the management policies of WB-supported projects and small hydropower development policies in China cause even more complications connected with the acquisition and utilisation of WB funds.

A thorough analysis of the challenges and constraints facing the scale-up development of small hydropower is conducted in this paper, based on the comparison between Chinese project management policies and those of the WB. A framework model of programme management is suggested, with a project management office (PMO) at its core and staged implementation and multi-level management constituting the methods used. The principles, advantages, and disadvantages of WB-financed Zhejiang Small Hydropower

programme management are also explained. We should also note that the model of programme management and methods put forward in this paper meet the requirements established by the WB for the projects which it finances. In addition, if the large number of small hydropower plants and their diverse locations are taken into account, this model of programme management would also contribute to reducing the duration of subproject construction as well as lowering the costs of implementation.

2. Differences in management policies between WB-financed projects and domestic hydropower projects

Ninety per cent of WB loans lent to members are for investment purposes, and as such, the management of investment projects represents a vital component in the Bank's lending work. There are, however, significant differences between the management of WB-financed projects and hydropower development policies in China, mainly concerning project approval, procurement and the management of funds, and environment/resettlement management. Specifically, these differences are as follows.

(1) The approval of feasibility studies and preliminary design reports for domestic hydropower projects, including the required documentation (e.g. written approval from the related governmental department), differ from the appraisal of WB-financed projects only in terms of consultancy and review entities. The management of WB-financed projects should adhere to the technical procedures mentioned above (including project appraisal and approval) to ensure that they meet the Bank's appraisal standards as well as the domestic governmental approval process.
(2) The tendering and bidding policy for hydropower projects in China differs from the requirements laid down in the WB's Procurement Guidelines [18] in terms of practices relating to procurement methods, pre-qualification, bidding time, contract award, and bid evaluation. In the management of WB-supported projects, attention should be paid to fund procurement and management that meet the Bank's procedural requirements in order to avoid unqualified procurement, which would be ineligible for reimbursement.
(3) The WB's policies and procedures on environment and resettlement are more concerned with public involvement and consultation. More importance should therefore be attached to these issues in order to satisfy WB requirements.
(4) The financial management of WB-supported projects is mainly based on relevant domestic policies. Project auditing is conducted by the pertinent auditing department in accordance with domestic regulations. However, WB loans are disbursed to domestic owners who have already paid investment expenses; the WB's project financial statements are specifically intended to be different in form from domestic ones.
(5) The WB pays great attention to dam safety in new projects owing to the potentially serious consequences resulting from abnormal operation or accident. Detailed dam safety management requirements are specified in Operational Policies (OP) 4.37 [19] and Bank Procedures (BP) 4.37 [20], which differ from domestic rules and norms on dam safety management in terms of expert consultancy and review entity.

3. Challenges involved in the scale-up of small hydropower development in China using WB loans

Traditionally, small hydropower projects in China have been funded by local government or enterprises familiar with the domestic policies relating to hydropower development. Although independently owned capital and management resources for these projects are relatively limited, investors are still able to accomplish their objectives at a low management cost. Not only does WB financing provide new opportunities for development and promotion, but it represents a series of challenges, which are detailed below, concerning traditional small hydropower development and management.

(1) The fact that the present small hydropower administration and project owners are not acquainted with the management policies of WB-financed projects could result in an irregular use of the loan.
(2) The utilisation of a WB loan increases the work-load and adds complications to project development. The owners must not only complete the domestic approval procedures for hydropower plant construction, but must also go through the Bank's appraisal procedures before the Loan Agreement and Project Agreement are signed.
(3) Due to the small size of individual hydropower projects and poor management, owners are unable to go through the domestic approval and WB appraisal procedures on their own, and, as a consequence, there are high internal risks involving the procurement and financial management of these projects.
(4) Compared with other projects financed by the WB, where individual small hydropower projects are concerned there is little opportunity to obtain governmental approval for an application for a WB loan due to the small size of the funds required. In addition, a small hydropower project owner would incur high incremental costs for project implementation because the life cycle of a WB-financed project is usually very long. An application for financial aid from the WB therefore runs contrary to the financial interests of a small hydropower project owner.
(5) During the implementation of WB-financed projects, the Bank usually sends out consultants on environmental, resettlement, and dam safety matters so as to follow up and supervise the implementation of a project. However, when small hydropower projects are undertaken in groups, it is impossible for the Bank's consultants to supervise so many projects, which are not only small in size, but are also located in many different places.
(6) Fund management is an important part of the overall integrity of WB-financed projects. On each small hydropower project, detailed procurement plans are supposed to be prepared and submitted to the Bank for approval. Due to the large number of these projects, proposal evaluation would realistically be inefficient.

4. Programme management strategy for small hydropower scale-up development

4.1. The necessity for an effective programme management strategy

The scale-up development of small hydropower would usually involve many small inter-related hydropower projects (i.e. subprojects) with a number of characteristics in common. For instance, they might have common construction procedures and administration, as well as needing to go through similar application and management procedures for WB financing. Although small hydropower subprojects have their respective goals concerning economic and financial returns, their common strategic objectives include energy efficiency, the reduction of emissions,

and the promotion of renewable energy source development. Indeed, if subprojects share social or institutional resources, including, but not limited to, policy consultation, technical guidance, intermediary service, bidding and procurement, supervision and risk control, then, as a result, the cost of development would be significantly reduced and the overall strategic goal of such programmes would be realised, as the WB and GOC attest.

Despite these common characteristics, conditions unique to clusters of small hydropower subprojects require the adoption of tailor-made measures so as to advance small hydropower and to solve the diverse problems facing individual subprojects. According to the traditional model of project management, the opposing terms "scale-up" and "tailor-made" are difficult to implement simultaneously for small hydropower development [21,22]. With the growth of programme management, the strategy of a "programme" could be applied and new breakthroughs for the scale-up of small hydropower development promoted.

Researchers [23–27] have proposed the following definition of a programme: a portfolio of projects that is managed in a coordinated manner to provide benefits that would not be possible had the projects been managed independently. PMI [28] defines programme management as the centralised coordinated management of a group of projects so as to achieve overall strategic objectives. Ma et al. [29] divide programmes into two categories according to the different relations between projects, that is, "competing programmes" and "coordinating programmes". Gray [30] divides programmes into three types according to their degree of combination: "loose", "strong", and "open". Based on the different targets for these programmes, Wang et al. [31] classify them as: "constraint-oriented", "customer-oriented", "product-oriented", and "strategy-oriented". The concept of programme management has been of considerable value in the fields of construction [32,33] and spatial development [34].

Based on the foregoing analysis and discussion, it is reasonable to say that small hydropower projects in a scale-up development have the features required of a programme. It is therefore necessary to adopt a strategy for programme management in order to ensure the successful acquisition and utilisation of WB loans, to lower administrative costs, and to decrease risks incurred in their developmental process.

4.2. Three-dimensional integrated programme management model

Project management is oriented toward the objectives of an individual project. It focuses specifically on the management of capital, progress, and quality. The project management team participates in all areas of management during a particular project cycle [35]. Programme management, by contrast, is oriented towards a variety of strategic goals involving multiple projects [30,36] and focuses on integral planning, control, and coordination. Typically, the programme management team does not play a direct role in the day-to-day administration of individual subprojects.

Integrated management is the key to programme management. As is shown in Fig. 1, integrated programme management incorporates various factors involved in the programme for the following three dimensions: integrated administrative organisation, integrated management factors, and integrated processes [37]. The connexion of different programme stages can be strengthened by process integration, which is achieved through good communication. The integration of management factors provides a general project roadmap, and goals and factors are considered in order to optimise efficiency. The integration of the administrative organisation is intended to strengthen the communication and cooperation among project stakeholders, to tap the potential of the subproject organisational system fully, and to improve overall programme management.

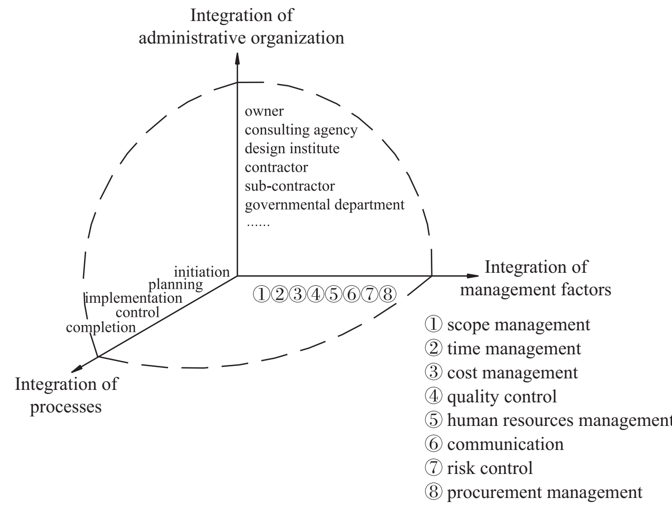


Fig. 1. Integrated programme management model [37].

4.3. Programme management office

Programme management activities are conducted by a Programme Management Office (PMO). Containing as few team members as possible, a PMO is at the head of the strategic division, overseeing all management activities, strategic organisational objectives, and high-level management [36,38]. A PMO performs the following functions at various stages of programme management [39]. (i) Programme identification: a PMO sets up programme objectives in accordance with an organisational strategy, defines its own place in the operational and development process, and provides programme boundaries. (ii) Programme planning: a PMO reifies the objective defined at the previous stage by forming the programme's administration, designing an implementation scheme, assigning responsibilities among staff, and allocating resources. (iii) Programme implementation: the programme manager is responsible for supervising and controlling the progress of each subproject, coordinating subprojects, evaluating risks, and handling disputes to ensure that the programme's strategic objectives are reached in a timely fashion. (iv) During the final stage of the programme, the PMO assesses the fulfilment of strategic targets based upon objective completion.

5. Case study involving the Zhejiang small hydropower programme

5.1. Background

Zhejiang Province, located in the southeast of China, is currently enjoying rapid social and economic development. For the past five years, the GDP has increased at an average rate of 11.8%. Zhejiang is rich in hydropower resources with an estimated exploitable hydropower capacity of 8620 MW, of which 4620 MW can be produced by small hydropower. Over 3175 small hydropower plants with an individual capacity of less than 50 MW had been constructed across the province by 2011, producing a total capacity of 3699 MW; the exploitation rate of small hydropower resources has reached 80% within the province. Although Zhejiang ranks sixteenth among all the provinces and municipalities in the country in terms of small hydropower resources, their developed capacity ranks sixth and its exploitation rate ranks fourth. Installed small

hydropower capacity comprises 6.5% of the total installed generation capacity of the province. As of June 2011, Zhejiang had obtained WB financing amounting to US$2739.24 million, accounting for 5.57% of the total loans to China by the Bank. Due to the outstanding efficiency of hydropower management and production, positive environmental impact assessments, and favourable real estate development policies, the WB and GOC consider Zhejiang a pilot province for the CRESP initiative.

5.2. *Management framework*

In July 2004, the Zhejiang Small Hydropower Programme was listed as one of the candidates for WB financing, and a management organisation was promptly set up (Fig. 2). A provincial PMO was established for both programme and subprojects and respective PMOs were also established at county level. The provincial PMO coordinated relevant departments, such as the Zhejiang Provincial Development and Reform Commission, the Zhejiang Provincial Department of Finance, the Zhejiang Provincial Department of Water Resources and the Zhejiang Provincial Department of Land Resources. It also managed the planning, finance, technology, and construction of the programme. County PMOs were responsible for coordinating and implementing subprojects under their respective jurisdiction. Key activities such as programme integration, fund procurement, environment and resettlement, and dam safety were managed by the provincial PMO, which remained the programme's core management office (see Fig. 2 for the management framework). The Zhejiang Small Hydropower management complied with the relevant regulations set forth by the WB and the GOC, ensuring successful and efficient programme implementation.

5.3. *Possible constraints and risks*

The constraints and risks of the Zhejiang Small Hydropower Programme, arising in part from differing management policies between WB-financed projects and domestic hydropower regulations, are shown in Table 1.

5.4. *Realisation of the Zhejiang small hydropower programme management*

5.4.1. *Programme integration*

In 2005, 114 small hydropower plant operators submitted documents required for domestic approval. Based on the submitted materials, the provincial PMO screened the subproject candidates and selected 18 to participate in the Zhejiang Small Hydropower Programme (see Table 2, Figs. 3–4 for details). The PMO then prepared a final report, applying for WB financing after an analysis and assessment of the economic, financial, social, and environmental aspects of the subprojects had been conducted. The PMO prepared and submitted framework documents (the Project Implementation Plan as it was referred to by the Bank) in accordance with the Bank's policies on the management of the projects which it finances and with the relevant laws and regulations established by the Chinese government. The funds from the Bank were successfully received in December 2005 when the Project and Loan Agreements were signed. All programme preparation procedures were completed within 17 months, which was much faster than the usual 24–36 month preparation period.

5.4.2. *Programme appraisal*

Unlike the usual projects financed by the WB, which are usually evaluated in one stage, the appraisal of the Zhejiang Small

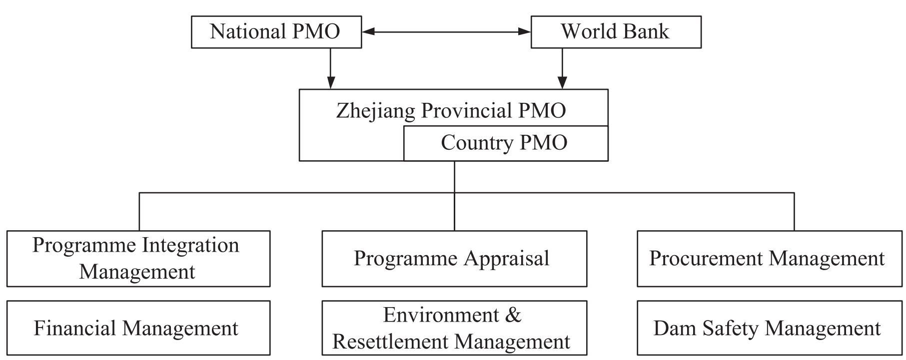


Fig. 2. Management framework for the Zhejiang Small Hydropower Programme.

Table 1
Constraints and risks of the Zhejiang Small Hydropower Programme.

Key activities of programme management	Programme constraints	Programme risks
Programme management organisation; programme integration; programme appraisal.	Selection of subprojects by GOC and WB; programme approval by GOC; programme appraisal by WB; negotiation and signing of Loan Agreement and Project Agreement.	Programme not constituted; programme approval not completed; programme appraisal not completed; not eligible for WB financing.
Procurement management	Guideline for Procurement under IBRD Loans and IDA Credit (WB Procurement Guideline)	Issues relating to procurement
Environment management	WB's environmental policies and national laws and rules on environment	Environmental risks
Resettlement management	WB's resettlement policies and national laws and rules on land and land requisition	Resettlement risks
Dam safety management	WB's dam safety policies and national rules and regulations on dam safety management.	Dam safety risk
Financial management	Financial covenants in Loan Agreement and Project Agreement, and related national financial regulations for WB-supported projects	Financial risks

Table 2
Survey of the Zhejiang Small Hydropower Programme.

Plant name	Type	Original capacity (kW)	Capacity after construction (kW)	Cost (US$10,000)	Bank financing (US$10,000)	Commission date	Note
S1	Reno.	2800	3500	93	77	Mar. 2006	
S2	Reno.	640	1000	59	46	Apr. 2006	
S3	Reno.	640	1260	114	73	Mar. 2007	Change of owner
S4	Reno.	800	1800	74	47	Aug. 2006	
S5	Reno.	8000	10000	414	319	Dec. 2006	
S6	New	–	3200	362	136	Oct. 2007	
S7	New	–	1600	178	67	Oct. 2007	
S8	Reno.	5130	6230	176	139	Jun. 2008	
S9	Reno.	1000	1600	44	44	Jun. 2008	
S10	Reno.	6400	7200	185	146	May 2007	
S11	Reno.	400	2500	308	124	Dec. 2010	
S12	Reno.	570	1200	208	130	Nov. 2010	
S13	New	–	5000	452	254	May 2008	
S14	New	–	2000	201	73	Feb. 2007	
S15	New	–	800	86	34	Mar. 2007	
S16	New	–	1000	105	59	Nov. 2010	
S17	Reno.	–	–	–	0	–	withdrawn
S18	New	–	–	–	0	–	withdrawn
		26380	49890	3060	1768		

Note: In the table, “Reno.” stands for “Renovation”.

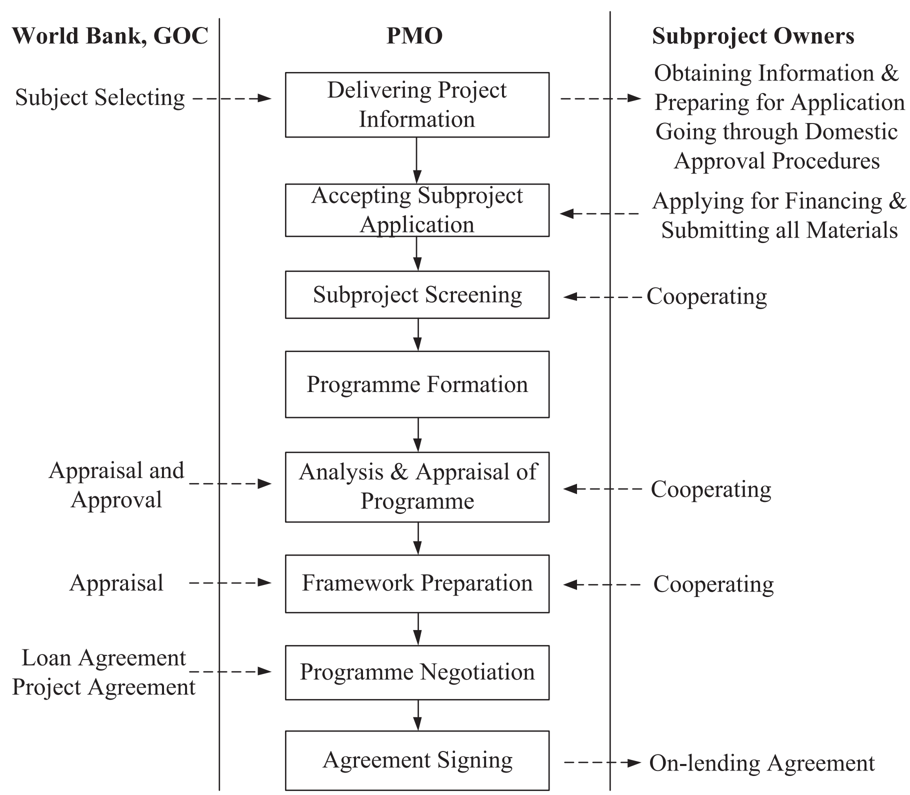


Fig. 3. Integration flowchart for the Zhejiang Small Hydropower Programme.

Hydropower Programme was divided into two parts (see Fig. 5). Before the programme negotiations, the Bank approved the management organisation and the programme framework, but no specific assessment was made on individual subprojects. When the negotiations had been completed and the implementation stage had commenced, the appraisal of subprojects was conducted by a provincial PMO, to which the task had been entrusted by the Bank. The PMO organised experts to assess the subprojects in batches in accordance with the procedures and standards specified in the framework, covering Technical Due Diligence, Environmental Impact Assessment (EIA), Resettlement Action Plan (RAP) and the dam safety evaluation of each subproject. Only after the appraisal of a subproject had been approved by the Bank could the loan proceeds be utilised. The aforementioned model sped up programme appraisal and costs were reduced in consequence.

5.4.3. *Procurement management*

The procurement of industrial goods and civil services was made through International Competitive Bidding (ICB), National

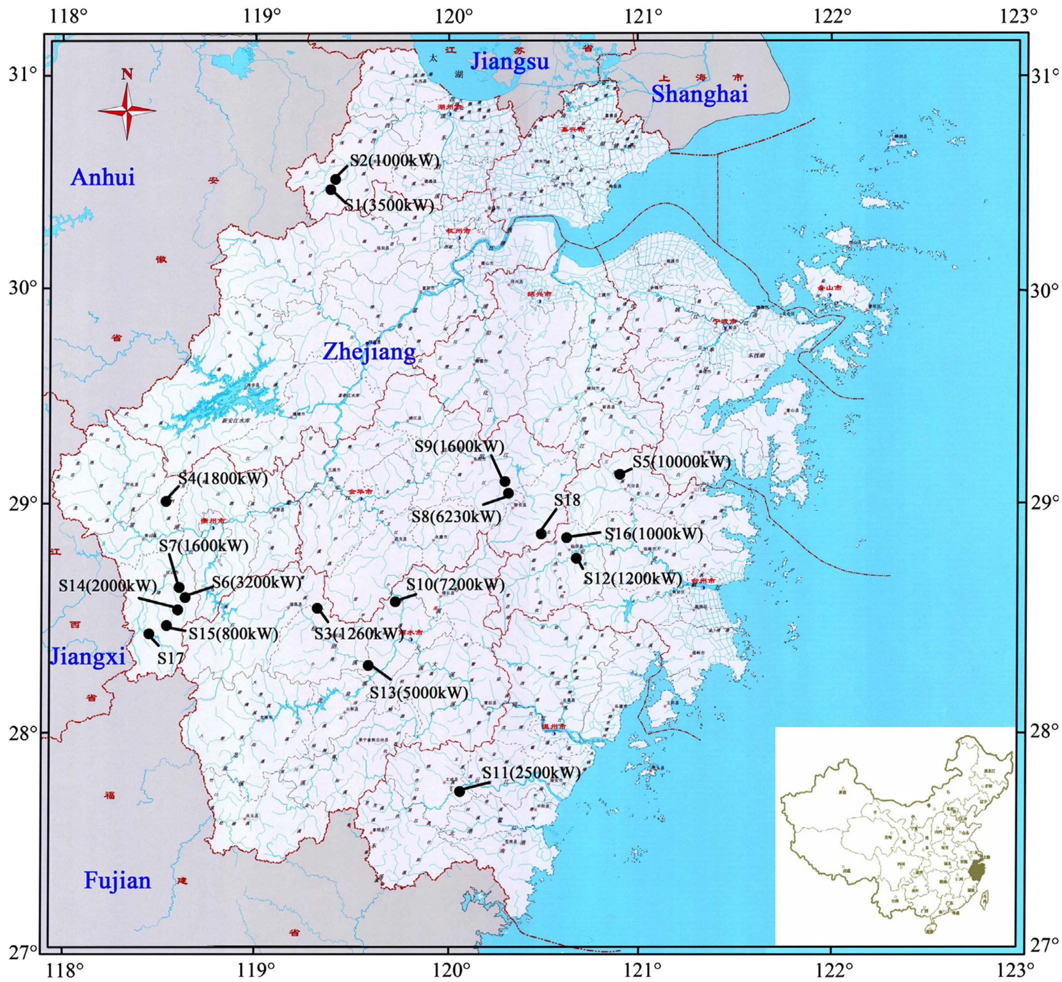


Fig. 4. The location of the Zhejiang Small Hydropower Programme.

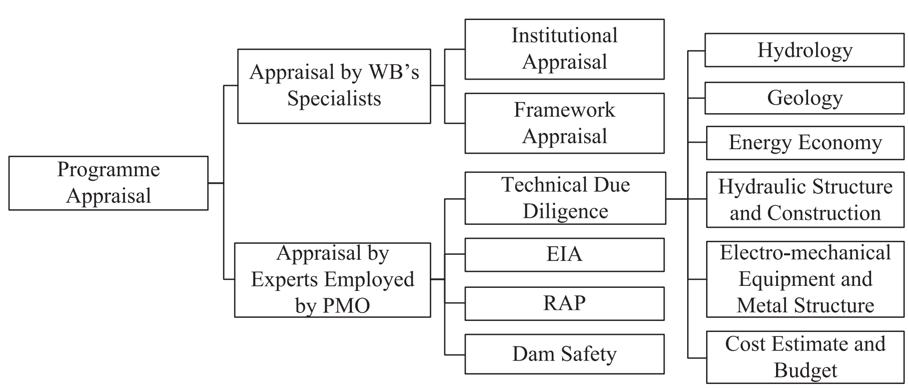


Fig. 5. Appraisal of the Zhejiang Small Hydropower Programme.

Competitive Bidding (NCB), and inquiries, which were subject to prior review by the Bank. The procurement management flowchart for the Zhejiang Small Hydropower Programme is presented in Fig. 6. Procurement management on this programme differed from usual practices on WB-financed projects in several ways. Firstly, there were a number of subproject owners; with some subprojects belonging to the state and others being privately owned. Secondly, there were hundreds of small contracts. After consulting with the Bank, a multi-level procurement style of management was adopted for the programme.

5.4.4. Financial management

Financial guarantee, the management of loan proceeds and auditing were identified as the crucial concomitants of the financial management of the programme. To ensure the sound allocation and repayment of WB loans, hierarchical financial guarantees were required while applications for subproject financing by the WB were being submitted. That is, first of all financial guarantees had to be obtained from the government bodies of the counties where the subprojects were located, followed by the government bodies at provincial level, and finally from central

government at national level. Once the WB loans had been obtained, the proceeds were on-lent from national to provincial level, down to county level, and finally to the owners of the subprojects. During the implementation of the programme, the Provincial Department of Finance undertook responsibility for withdrawing loan proceeds from the Special Account and reimbursing subproject owners, and the PMO was responsible for examining and approving disbursement applications and other financial activities. The management of loan proceeds allocated to the programme is shown in Fig. 7. Auditing was conducted by the Zhejiang Provincial Audit Office as authorised by the State Auditing Administration. The provincial PMO was responsible for submitting audited annual financial reports to the WB Beijing Office by June 30 each year. The reports consisted of two parts, namely financial statements and supplemental documents.

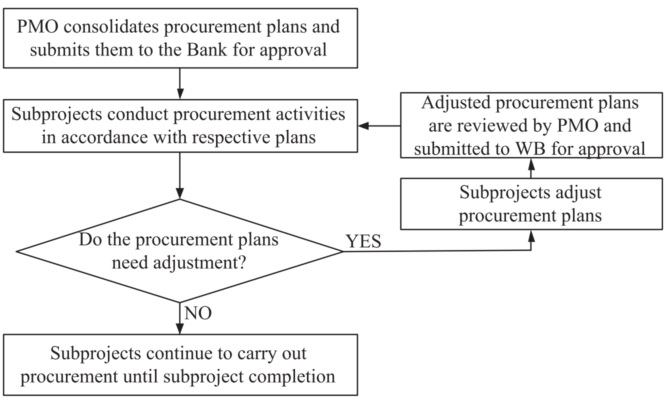


Fig. 6. Flowchart for procurement management.

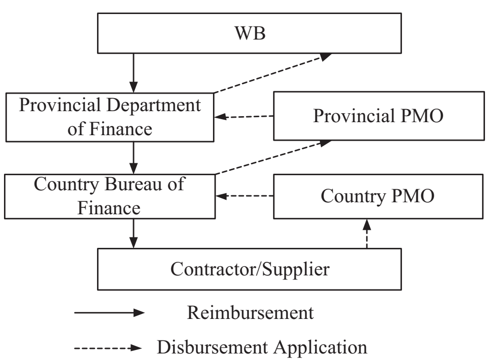


Fig. 7. Financial management flowchart.

5.4.5. Environment and resettlement management

Environmental assessment (EA) and resettlement procedures were examined by the WB first of all. During the subproject approval process, owners submitted the appropriate documents provided in the guidelines, individualised their respective environment and resettlement procedures by adding special subproject information, and finally formulated their respective Environment Management Plans (EMP) and Resettlement Management Plans (RAP) to ensure that they met the Bank's OP 4.01 and OP 4.12 regulations, as well as the relevant national regulations on environmental protection and land requisition. Environment and resettlement management is presented in Fig. 8. Third-party monitoring was conducted by an external monitoring agency employed by the PMO with the support of GEF funding.

5.4.6. Dam safety management

The programme involved the construction of several dams of over 15 m in height and reservoirs with a storage capacity of more than 1 million cubic metres. These understandably caused safety concerns. A dam safety panel was formed by the provincial government to carry out dam inspections and ensure that they complied with the Bank's safety guidelines. Dam safety was continuously assessed during subproject construction, and again upon completion (see Fig. 9).

5.5. Implementation effect of Zhejiang small hydropower programme

Yaxi Hydropower Plant Cascade I (S10 in Table 2) located in Lishui City was chosen as an example in order to demonstrate the implementation benefits of the programme. The plant possesses

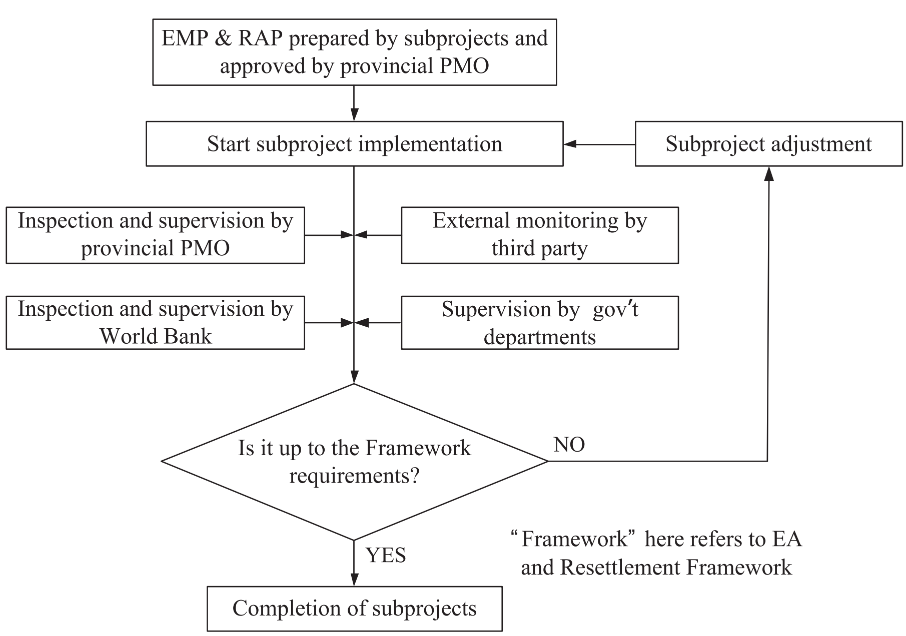


Fig. 8. Environment and resettlement management for the Programme.

an installed capacity of 4 × 1600 kW, a regular reservoir capacity of 22.30 million cubic metres, and a regulating capacity of 18.9 million cubic metres. Since its foundation in 1977, the plant had supplied nearly 500,000 MWh green electricity to Lishui City. However, after over thirty years of continuous operation, the aging water–turbine generator sets and auxiliary equipment failed to function properly. Due to the urgent need for a facility upgrade, the plant was included in the programme in July 2005. Plant refurbishment began in November 2006 and cost around US$2.08 million. WB financing of US$1.46 million was sought. In April 2007, new water–turbine generator sets were installed with a capacity amounting to 4 × 1800 kW and an annual energy production of 23,000 MWh. The plant was completely renovated, increasing its annual income by US$0.31 million. Owing to efficient programme management, the renovated plant was commissioned six months earlier than scheduled, and its maintenance cost was reduced by almost 20%, which was worth US$0.42 million.

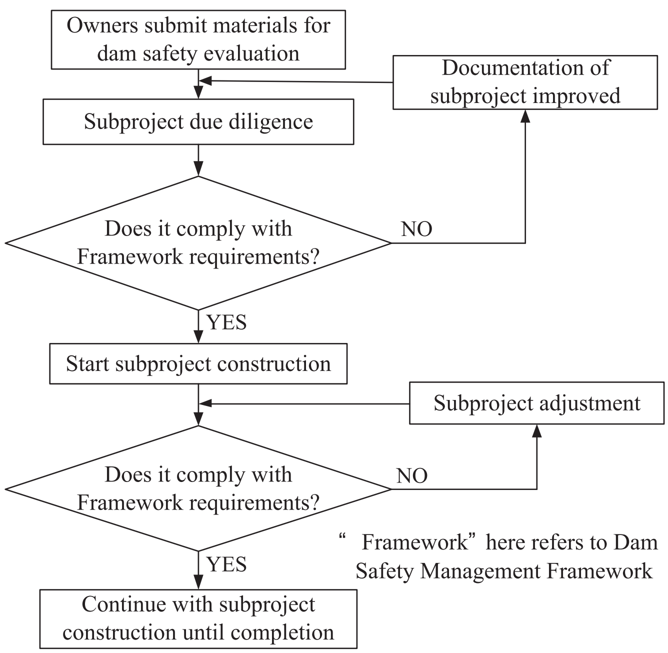


Fig. 9. Dam safety management flowchart.

The Zhejiang Small Hydropower Programme was in progress from June 2006 to December 2010, with a total duration of 54 months. Sixteen small hydropower plants were either renovated or newly built, and two hydropower plants, namely S17 and S18 in Table2, withdrawn from the programme due to dam safety issues or owner regulation non-compliance. In accordance with the procedures on programme change, the loan quota for S17 was transferred to S13 to use, and the loan quota for S18 was withdrawn by the Bank. The aggregate installed capacity of the 16 plants increased from the original 26.38 MW to the current 36.29 MW. The total cost of the programme was US$33.74 million, of which US$17.68 million was financed by the Bank. By December 2010, the total energy produced was 431.81 GWh, and significant social and economic benefits had been achieved.

5.6. *Analysis of the advantages of programme management*

The management of the Zhejiang Small Hydropower Programme not only complied with the requirements for WB-financed projects, but also took into full consideration the features of small hydropower in Zhejiang, such as the large number of subprojects and the disparate construction sites. The management model established for the programme, with a PMO at its core, as well as staged implementation and multi-level management at the periphery, allowed management flexibility, a flexibility, which was of paramount importance for the execution of the scale-up development of small hydropower. In Table 3, the style of programme management used in this case is compared with the usual management of WB-financed projects at all six stages of their execution. The management model and methods for the programme were fully recognised by the WB and GOC.

Table 3
Comparison between Zhejiang Small Hydropower Programme management and the USUAL management of other WB-financed projects.

		Other WB-financed projects	Zhejiang Small Hydropower Programme	Comments
Project cycle	Selection	Investigate with borrower, discuss lending plan and identify project candidates; project owners play their role.	PMO participates in the selection on behalf of subproject owners.	Programme management reduces work of the Bank and subproject owners, decreases cost of preparation, and favours programme implementation and strategy realisation.
	Preparation	Project owners prepare for the project and the Bank sends its experts to provide assistance.	PMO integrates the programme and conducts preparation works; subproject owners coordinate; the Bank sends its experts to provide assistance.	
	Appraisal	The Bank conducts appraisal on technical, financial, organisational, social and environmental aspects of the project; project owners coordinate.	PMO conducts appraisal and the Bank reviews; appraisal cost is covered by grants; subproject owners coordinate.	Involve national experts; lower programme risks; save time; reduce the Bank's appraisal cost; reduce subproject owners' cost incurred during preparation of appraisal.
	Negotiation	The Bank, borrower, and project owner take part in negotiations before signing the Loan Agreement and Project Agreement.	The Bank, borrower, and PMO negotiate, and the PMO signs the Agreements on behalf of the subproject owners and transfers loans to them.	Avoid precluding subproject owners from participating in negotiations; reduce cost of negotiations; make Agreement more suitable and practical for the programme.
	Implementation	The Bank dispatches consultants to inspect and supervise project implementation.	The Bank supports PMO development; PMO supports subproject owners; The PMO inspects, reviews, and supervises subproject implementation, with resulting costs covered by grants; the Bank dispatches consultants to conduct unscheduled inspections.	Avoid issues from insufficient WB consultant resources; reduce the Bank's inspection costs and the owner's reception costs; better coordinate and control subproject and lower programme risks; build owners' capacity and promote sustainable development.
	Post-evaluation	The owner prepares project evaluation report, and the bank completes post-evaluation report.	The PMO collects data and prepares evaluation report; the Bank completes post-evaluation report.	Foster the experience of summing up; reduce workload of subproject owners.

6. Discussion

Although the programme management of Zhejiang Small Hydropower proved effective, some issues still remain to be dealt with and improvements are expected in the future.

6.1. Programme alteration

Programme alterations result in management changes due either to unreasonable programme management constraints or regulation non-compliance by owners or management officials. In this case, three methods were implemented to protect against unplanned changes. (i) In the programme assessment stage, local governments were required to provide financial guarantees, and each subproject owner was required to provide credentials, internal financial management rules, and financial statements, which were all used to conduct a financial risk assessment. Only small hydropower plant owners who met requirements were included in the programme and provided with WB loans. (ii) In the programme implementation plan, the WB, GOC, and PMO reached a judicially notarised agreement concerning subproject increases and exits. (iii) The subproject owner had to apply for these, and when major changes occurred, such as exits from the subprojects, procurement plan changes, and changes in the amount of the loans, the WB and GOC gave the final approval.

It should be noted that in the usual management procedures in WB-financed projects, the WB generally assesses the projects first before signing the loan agreement. However, in the WB-Financed Zhejiang Small Hydropower Programme, when the WB, GOC, and PMO signed the Project and Loan Agreements, the 18 subprojects were only potentially involved after the initial screening and did not necessarily pass the full assessment carried out by the WB. Only the management procedures, rules, and framework of the programme were defined by the WB, GOC, and PMO in the signed Agreements. Possible changes to the subprojects were expected in the Agreements and corresponding procedures, making the exits of S17 and S18 a controllable risk. These changes did not affect the duration of the programme. Although the total installed capacity was less than originally planned, the financial indicators of each subproject were not affected due to the fact that each subproject was independently accounted for. Apart from financial indicators, the WB paid most attention to the exploration of the renewable energy policy presented in this paper, namely a framework model of programme management to promote scale-up development of small hydropower. The construction of these policies was not affected due to the withdrawal of two subprojects, and the WB considered that the programme had achieved the desired purpose.

6.2. Financial guarantee

A loan guarantee from the GOC is a prerequisite for financial assistance on any WB supported project; for the Zhejiang Small Hydropower Programme, an aggregate loan was guaranteed by the Ministry of Finance. Upon programme integration, all prospective subproject owners were asked to submit letters of financial guarantee from local government. Those who could not obtain a guarantee from local government were not eligible for WB financing. Currently, approximately 60% of small hydropower plants in Zhejiang are privately owned so that it is very difficult for the owners of these plants to go through procedures for securing financial guarantees from the government. More attention should be paid to the setting of constraints, such as scope alteration and financial guarantees at the level of programme integration, so that the strategic objectives of the programme would be more meaningful and easier to achieve. It might be more favourable for programme management and more convenient for decision-making if local government had more control and rights with regard to the use of the WB loan.

6.3. The PMO as intermediary

A management organisation for a WB-financed project is not a stand-alone unit. PMOs for the Zhejiang Small Hydropower Programme at both provincial and county level were staffed by employees transferred from other related administrative departments. As a WB-financed project cycle usually lasts more than five years, personnel changes often occur within the cycle, a factor which results in considerable difficulties in terms of programme management. Core management changes occurring during the transfer of staff members at the programme integration stage are particularly disruptive.

The authors of this paper would like to suggest that professional intermediary agencies might be employed by the PMOs to support the latter's programme management operations. An intermediary agency of this sort would be responsible for liaising with top management (e.g., the WB and the national governmental departments concerned) and subproject owners as well as for carrying out activities in accordance with the set strategic policies and constraints. The lead management for the programme would take responsibility for setting these policies and ensuring that the constraints are respected. With the support of a professional intermediary agency, a PMO would contribute to formulating a highly efficient and multi-level programme management organisation and system and accumulate programme management knowledge.

6.4. Programme information management

Compared with traditional project management, programme management requires managers to deal with more complex information since they need to coordinate and supervise a variety of subprojects located in different places at different stages of the programme. A programme management information system should have been established to improve the management efficiency for the Zhejiang Small Hydropower programme right at the outset, after identifying its features and clarifying the management process.

7. Conclusions and prospects

During the past thirty years, China has become the second largest country in terms of energy consumption, and energy demand continues to rise. In order to address energy shortages and reduce greenhouse gas emissions, the Chinese government is instituting energy policy reforms and plans to raise the proportion of renewable energies. As small hydropower is an important source of renewable energy with a huge potential for development, promoting the scale-up development of small hydropower is important for China and its cooperation with international organisations such as the WB and the GEF is mandatory. During the utilisation of WB financing, attention should be paid to the significant differences between the management of WB-financed projects and domestic hydropower project management.

In contrast to individual project management, small hydropower programme management is oriented toward the overall strategic goals of multiple subprojects and focuses on integral planning, control and the maximisation of the rate of resource exploitation. In this paper, the Zhejiang Small Hydropower Programme, which was part of Phase I of CRESP, has been discussed, firstly by examining the constraints related to programme management. The programme's key control points were then examined, and

an appropriate model of programme management established; this ensured the successful implementation of the programme and the achievement of its desired strategic objectives.

The model of programme management discussed here consists of programme management organisation, programme integration, appraisal, procurement, financial management, environment and resettlement management, and dam safety management, among other factors. The authors of this paper have referred to these factors as a “framework model of programme management with a PMO at its core” because the PMO is required to carry out management activities and because all the key parts relating to the management process were designed to serve as a framework. The model and its methods of staged implementation and multi-level management are of paramount importance for programmes supported by the WB.

Currently, there are an increasing number of programmes being implemented in China, such as the small hydropower plant renovation projects, reservoir reinforcement projects, drinking water projects for rural areas and water saving projects for large irrigation districts. The model of programme management discussed in the paper could be improved and adapted to the management of batches of subprojects in order to realise strategic benefits for these projects.

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